

Pediatric Musculoskeletal Ultrasound

Matthew R. Hammer, M.D.

Department of Radiology

Children's Health

UT Southwestern Medical Center

Disclosures

- No disclosures



Outline

- Fingers and thumb
- Shoulder in glenohumeral dysplasia
- Sonographic appearance of nerves

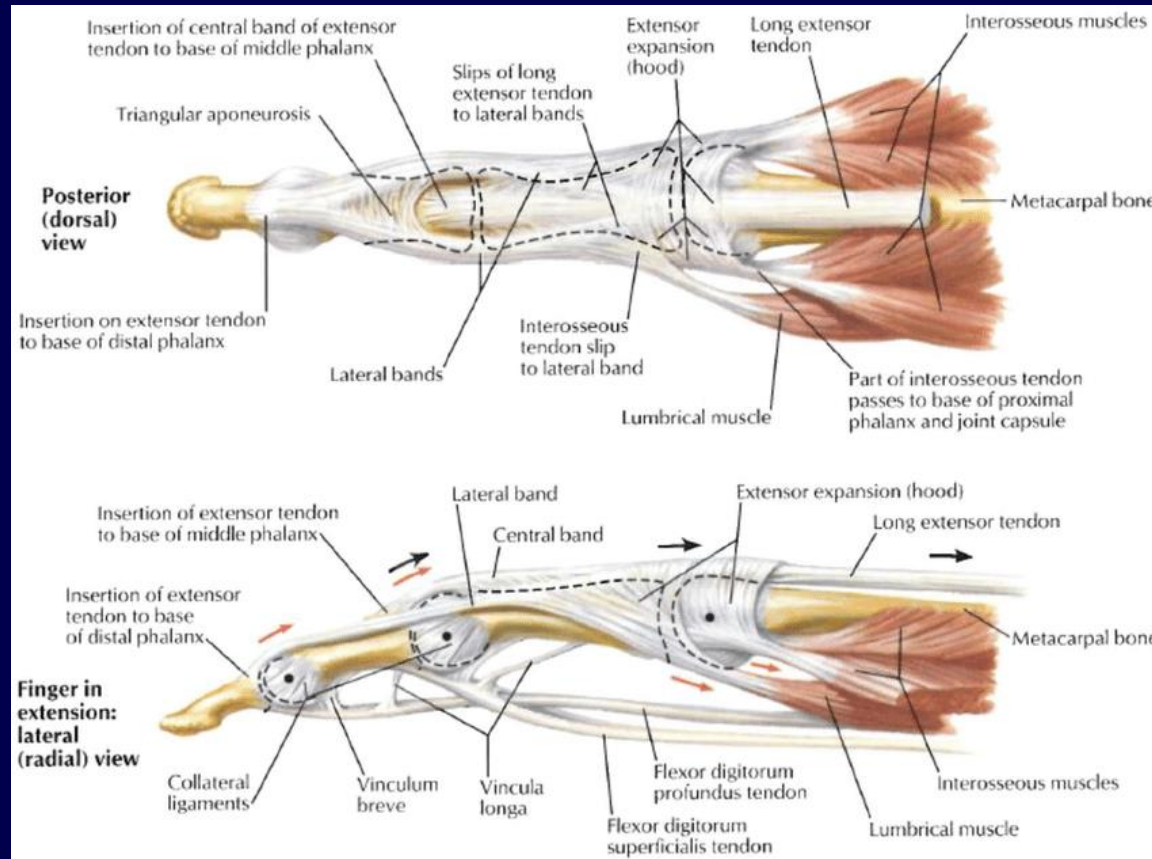
- Demonstration



Transducer Choice



Finger Anatomy

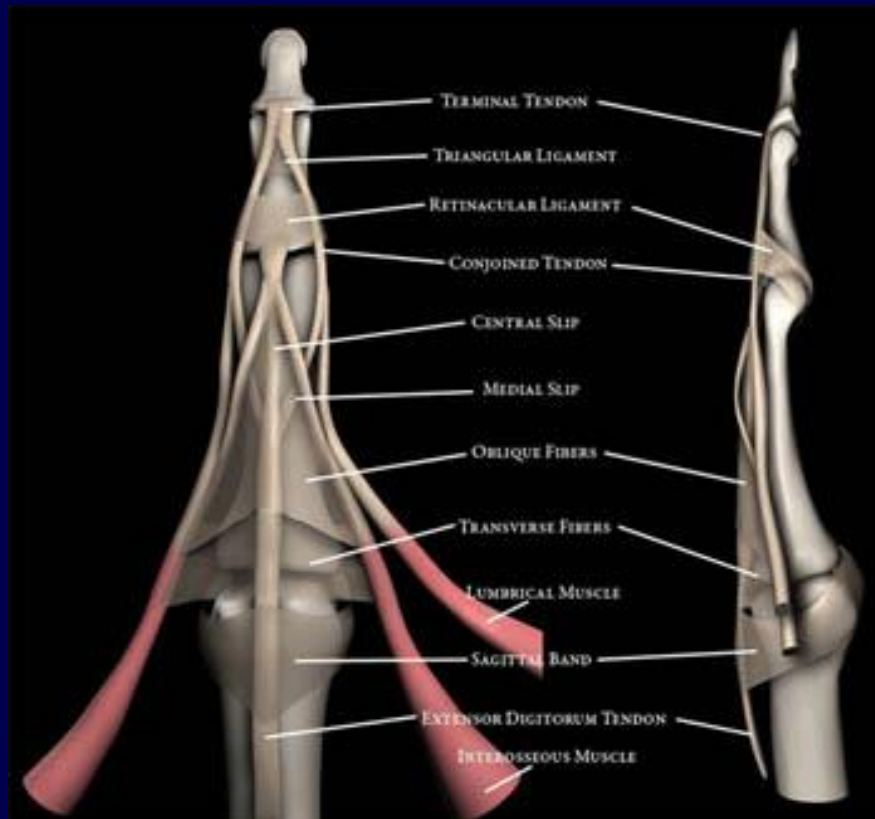


Netter 2002

Citation: Hu D, Howard D, Ren L (2014) Biomechanical Analysis of the Human Finger Extensor Mechanism during Isometric Pressing. PLoS ONE 9(4): e94533. doi:10.1371/journal.pone.0094533



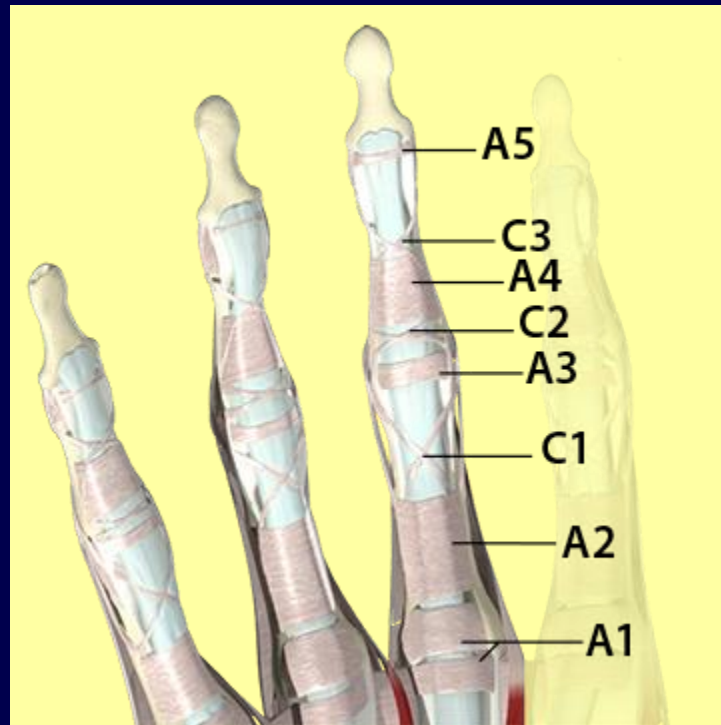
Finger Anatomy – Extensor



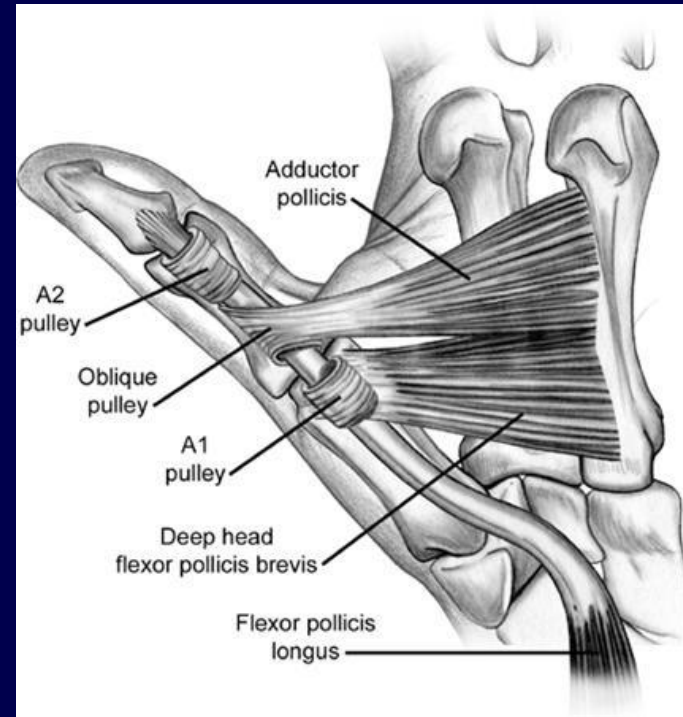
<http://radsourc.us> Illustration courtesy of Michael E. Stadnick, M.D.



Finger Anatomy – Supporting Structures



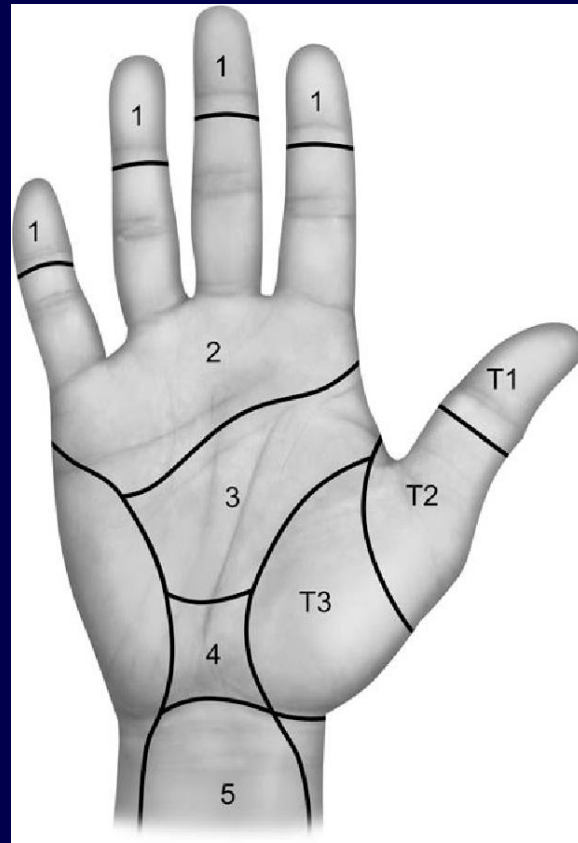
Primal Pictures Ltd. www.primalpictures.com



www.orthobullets.com



Injury Zones



Imaging



With the transducer along the volar thumb, the FPL can be viewed in the sagittal plane and gliding motion evaluated with passive flexion and extension of the interphalangeal joint, as tolerated



Normal Long Axis

Superficial, Volar

Distal



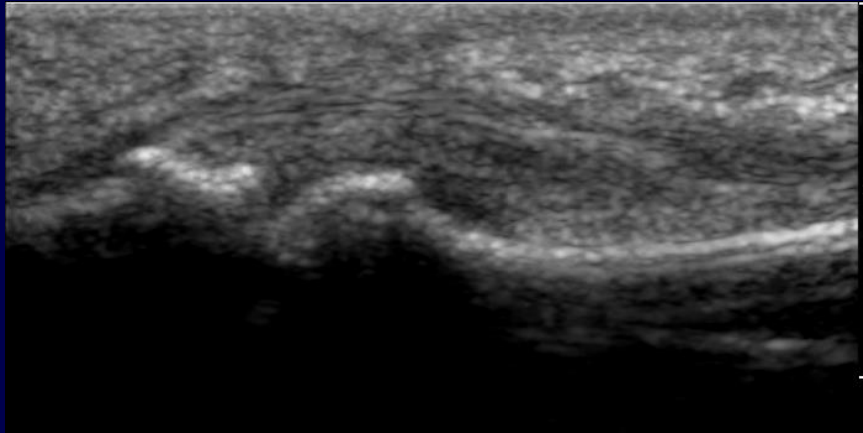
Proximal



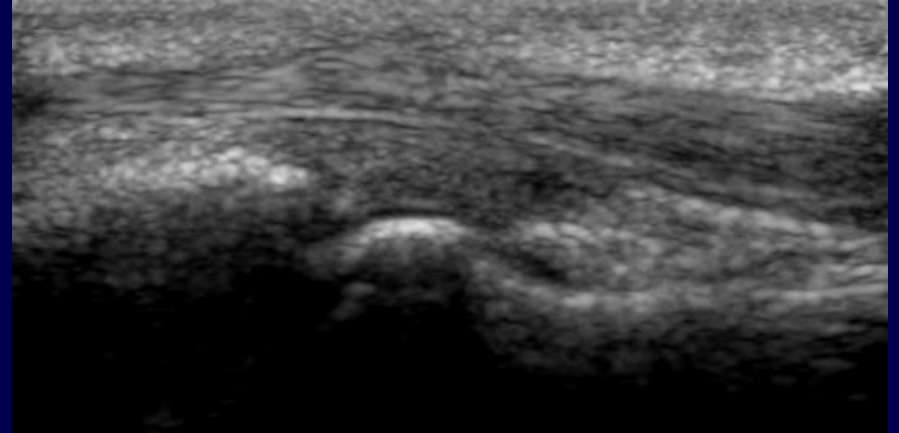
*A1 Pulley sometimes not visualized,
especially on sagittal view*



Normal Flexor



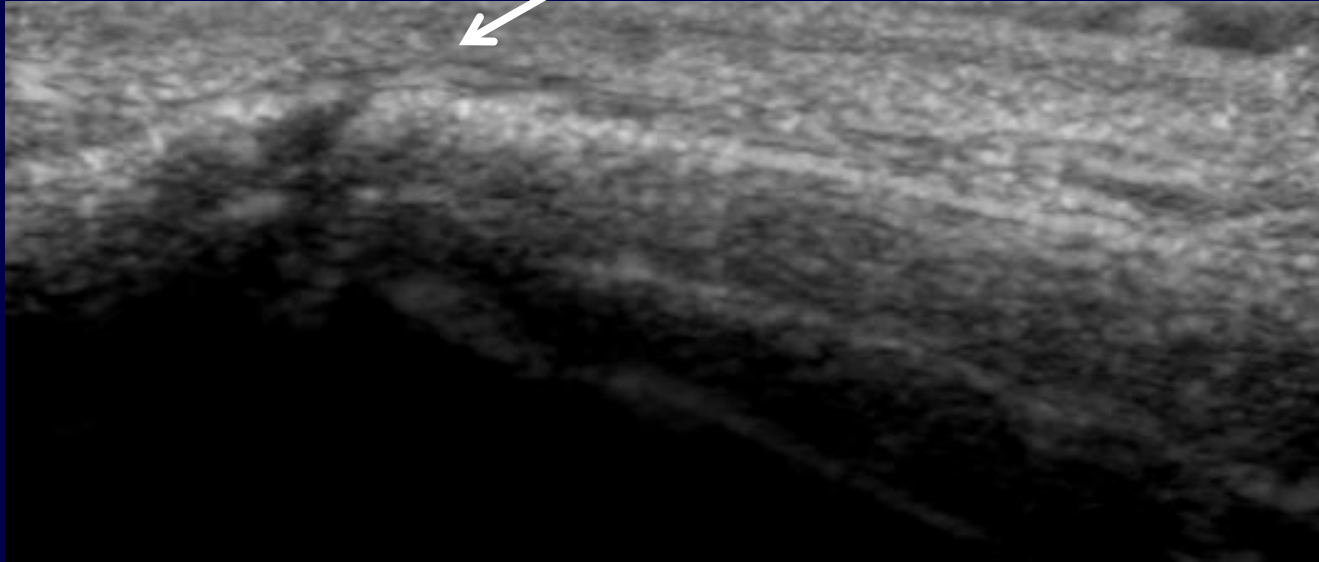
DIP



PIP



Normal Extensor



DIP



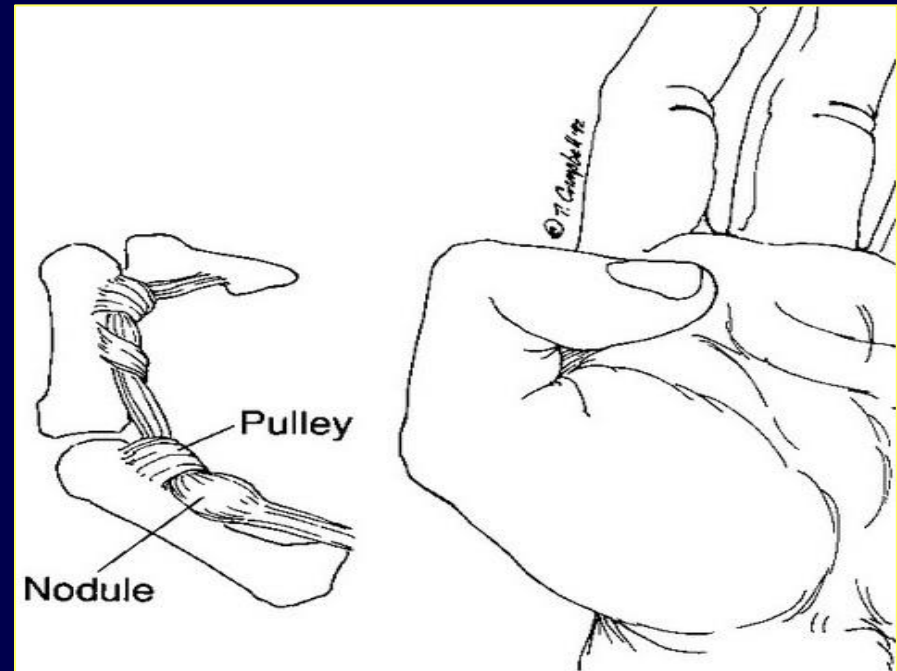
Pediatric Trigger Thumb

- Pediatric trigger thumb is a distinct entity from other pediatric trigger fingers or adult trigger fingers
- Estimated incidence of 3:1000 by one year of age, more common than clubfoot
- Average age at presentation near 2 years of age, supporting an acquired rather than congenital etiology, although the pathophysiology remains controversial
- Most children present with persistent flexion at the interphalangeal joint or snapping at the joint



Trigger Thumb

- Pediatric trigger thumb is abnormal gliding motion, usually with persistent flexion deformity, of the interphalangeal joint of the thumb
- Results from enlarged, nodular diameter of flexor pollicis longus (FPL) tendon compared to the A1 pulley canal that it travels through

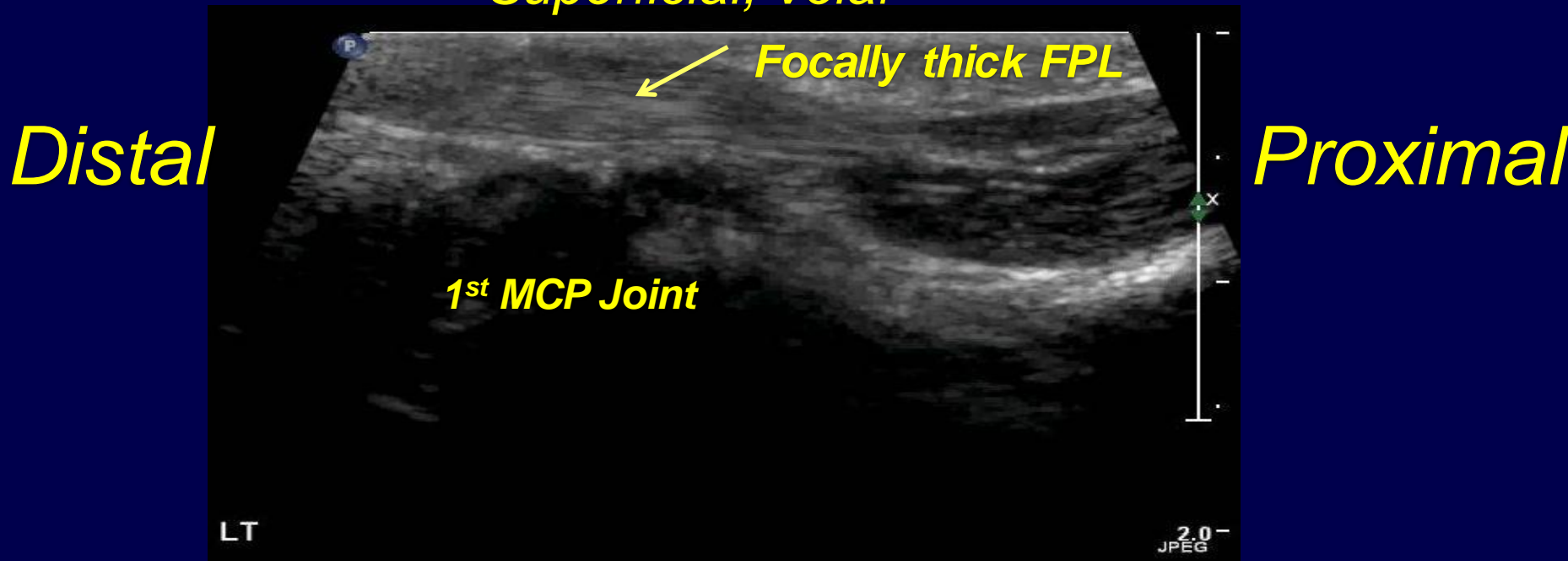


<http://pediatric-orthopedics.org>



Trigger Thumb

Superficial, Volar



Abnormal focal thickening of the FPL proximal to the A1 pulley, typical trigger thumb appearance



Trigger Thumb

Superficial, Volar



Level of focally thick FPL

Distal



Proximal

The thickened FPL 'bunches' near the A1 pulley as it cannot pass distally with extension at IP joint



Natural History and Treatment

- Nonsurgical management

- Observation, Passive extension exercises, Extension splinting

- Surgical management

- Release of A1 Pulley (open or percutaneous)
- Occasional recurrence or abnormal motion
- Potential for operative complications



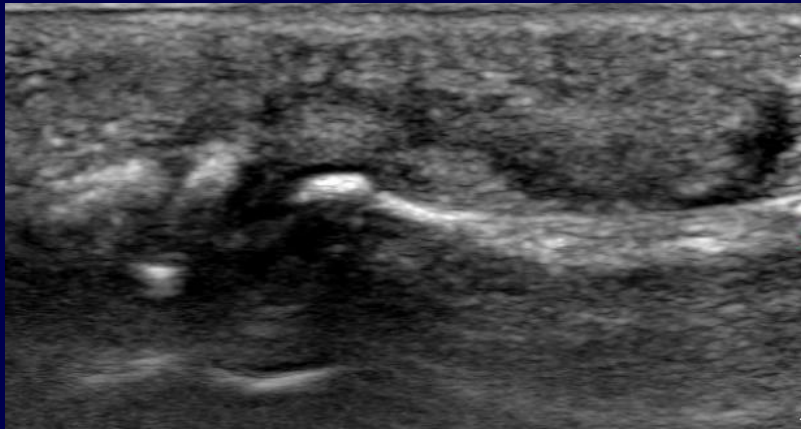
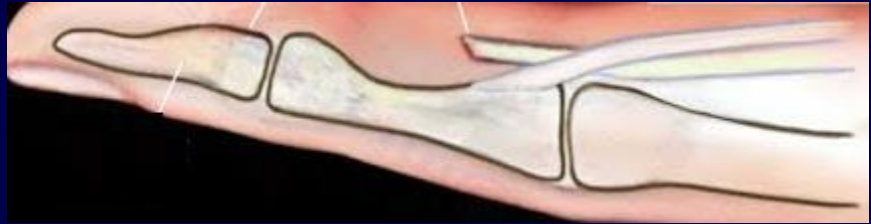
How Ultrasound Can Help

- Confirm classic pediatric trigger thumb findings
 - Abnormal echogenicity of the FPL tendon or abnormal A1 pulley morphology may suggest a different etiology
- Evaluate *asymptomatic* side to evaluate for risk of developing trigger thumb
 - Abnormal FPL morphology or trigger ratio less than 1.5 (max cross-sectional area FPL affected side compared to clinically normal side)
- Follow up



Flexor Disruption

- Jersey Finger



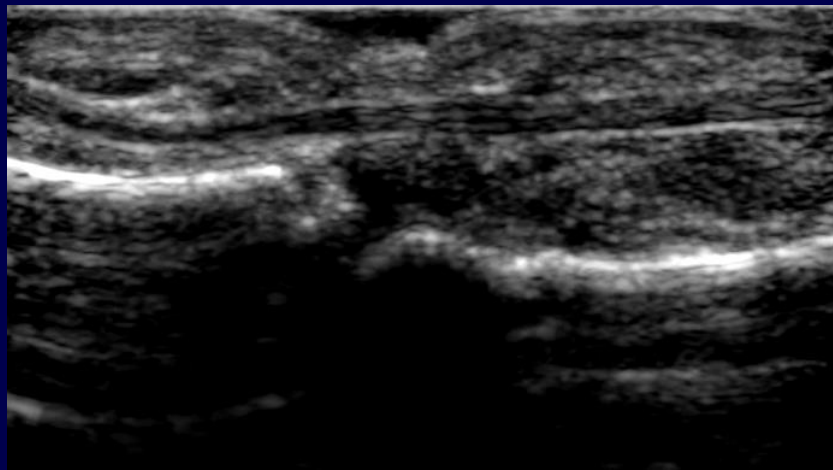
DIP



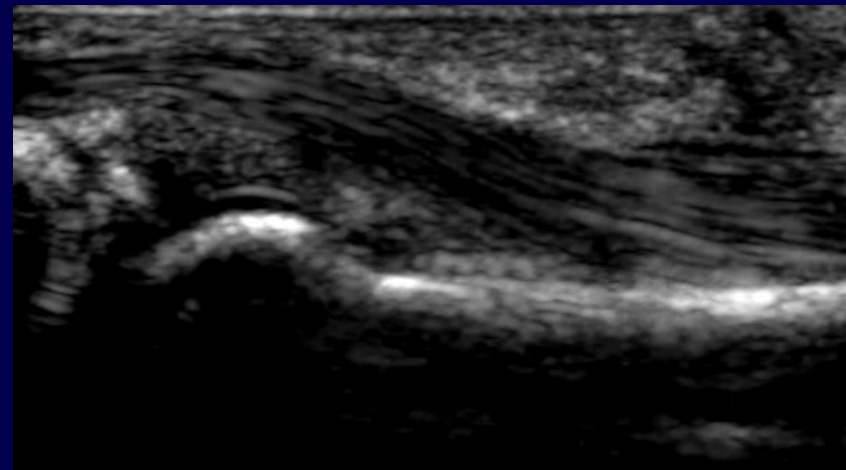
PIP

Postop and Pulley Injury

- Prior Zone 3 laceration repaired 3 years ago, new injury



PIP

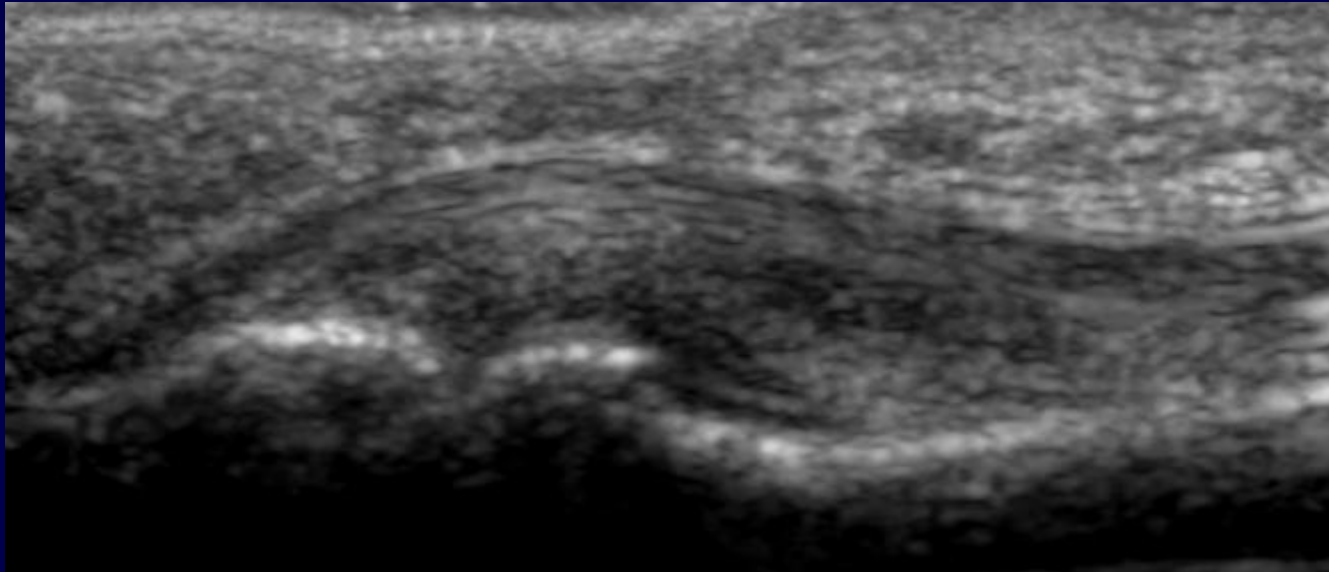


Contralateral PIP



Intact FDP

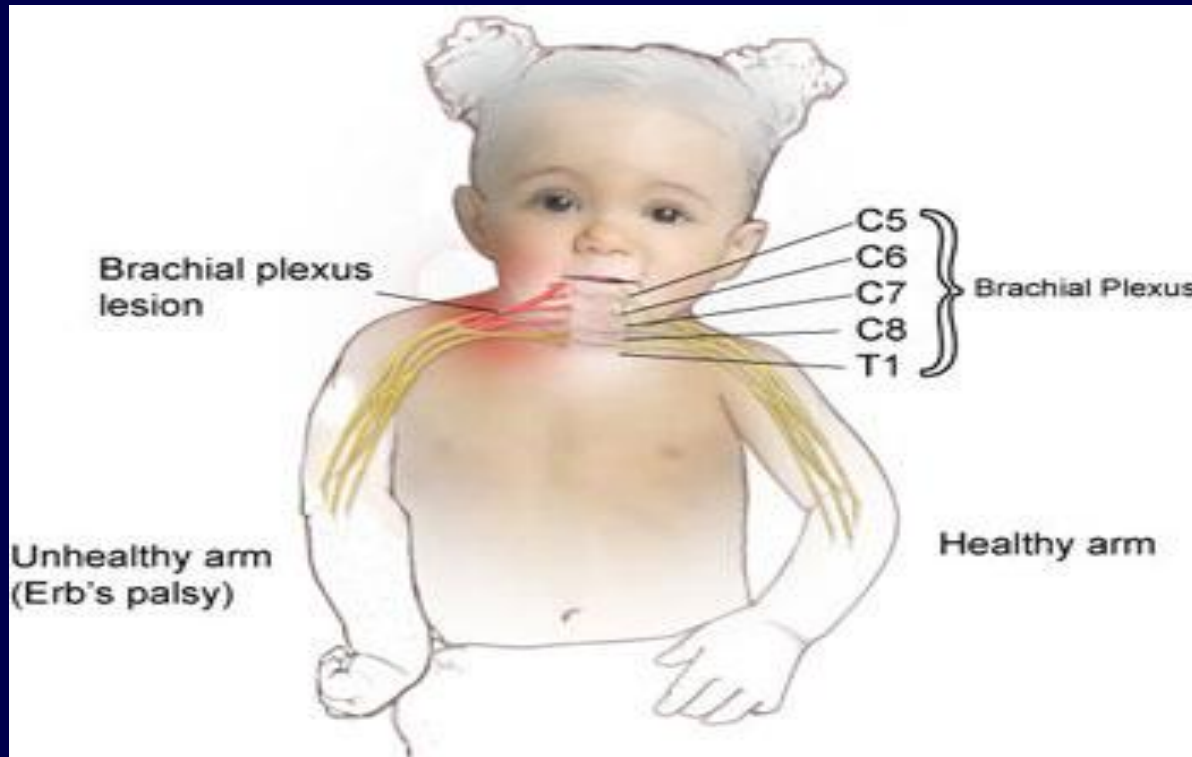
- Thick, injured VP after trauma



DIP



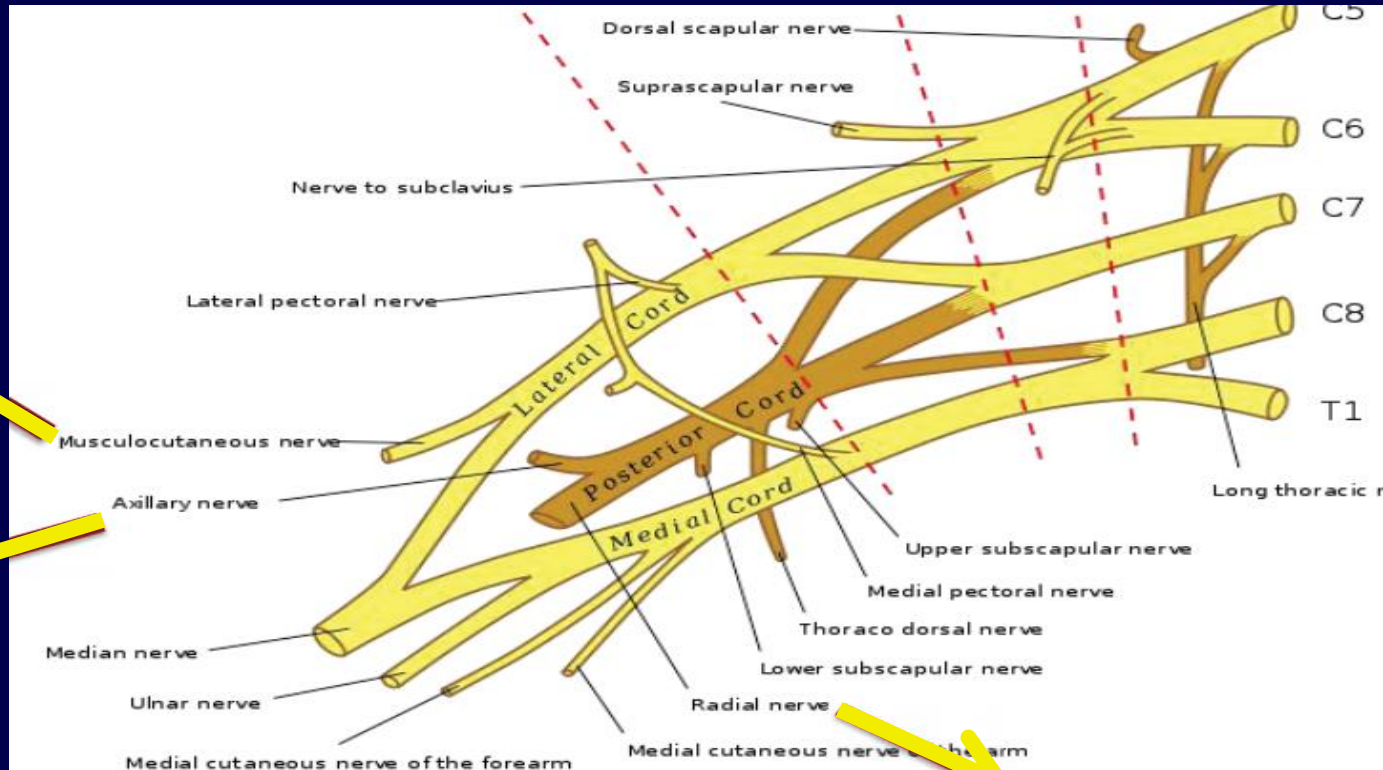
Brachial Plexus Injury



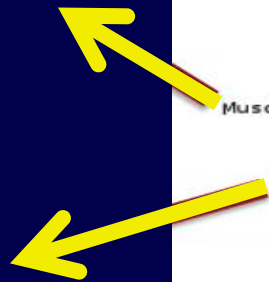
www.choa.org



Brachial Plexus



Biceps
Brachialis
Coracobrachialis



Deltoid

Brachioradialis



Brachial Plexus

- **Shoulder**

- Axillary – Deltoid (Abd, Flex, Ext)

- Musculocutaneous – Coracobrachialis (Add, Flex)

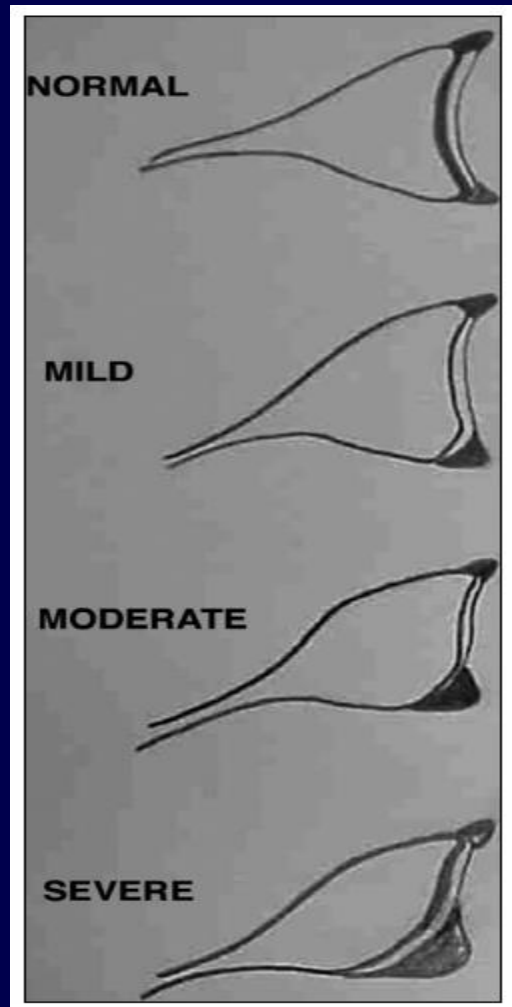
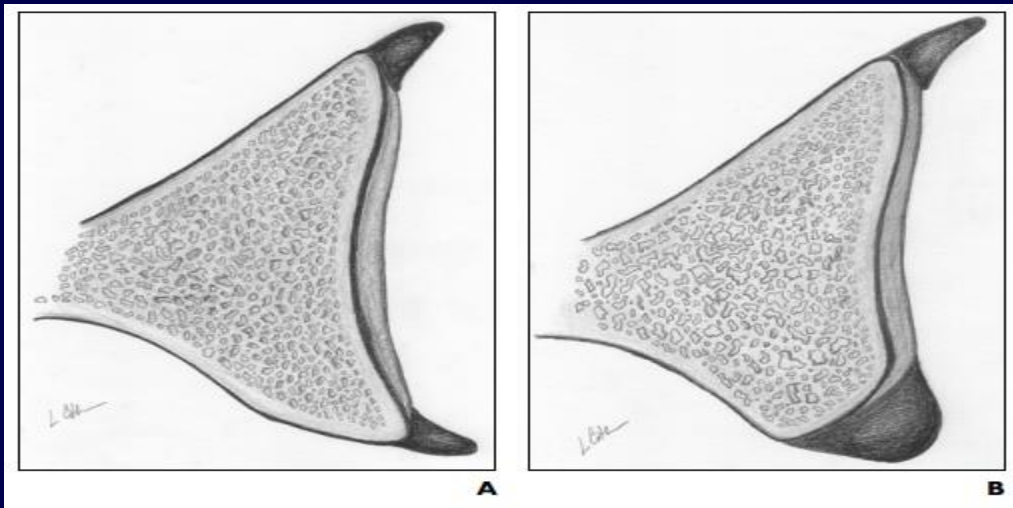
- **Elbow**

- Musculocutaneous – Biceps (Flex, Sup)

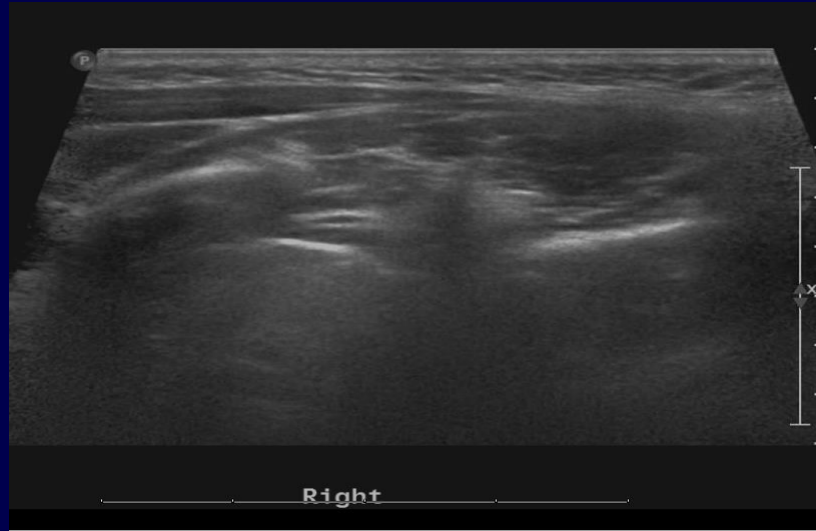
- Radial – Brachioradialis (Flex)



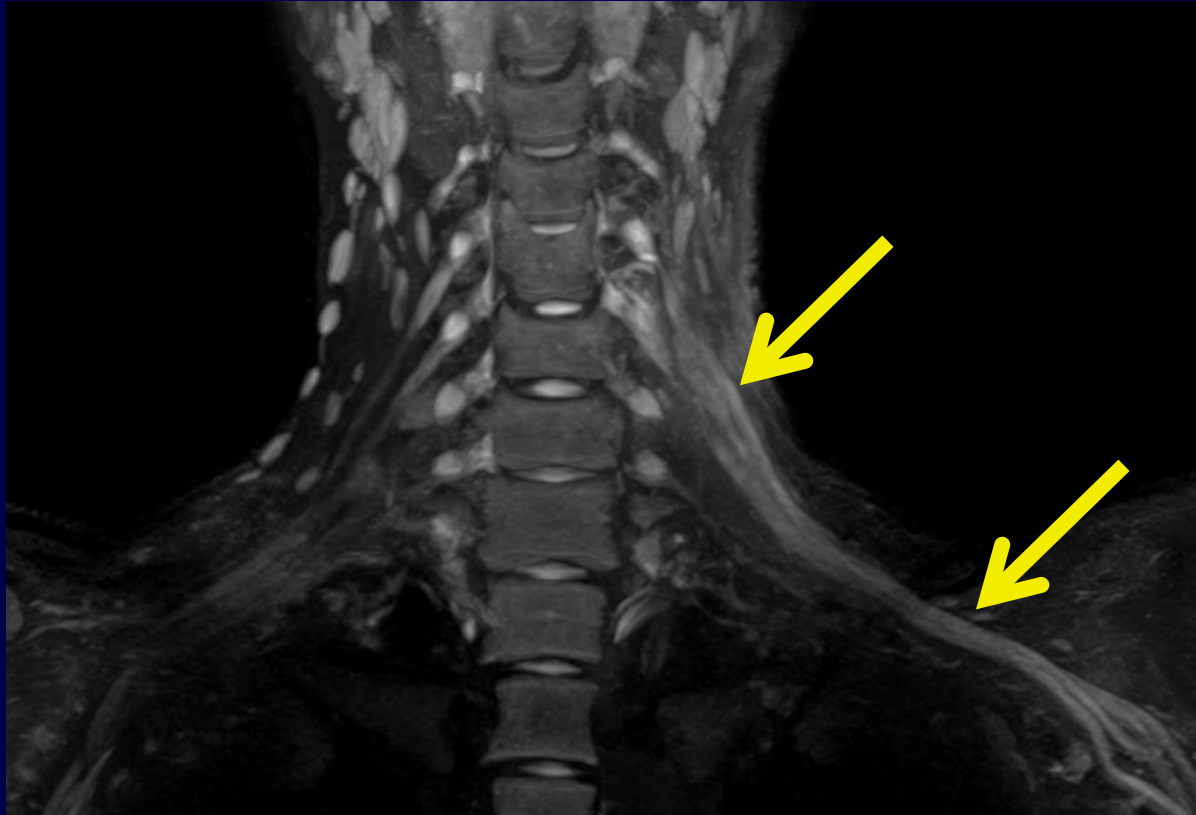
Glenoid



BP Injury



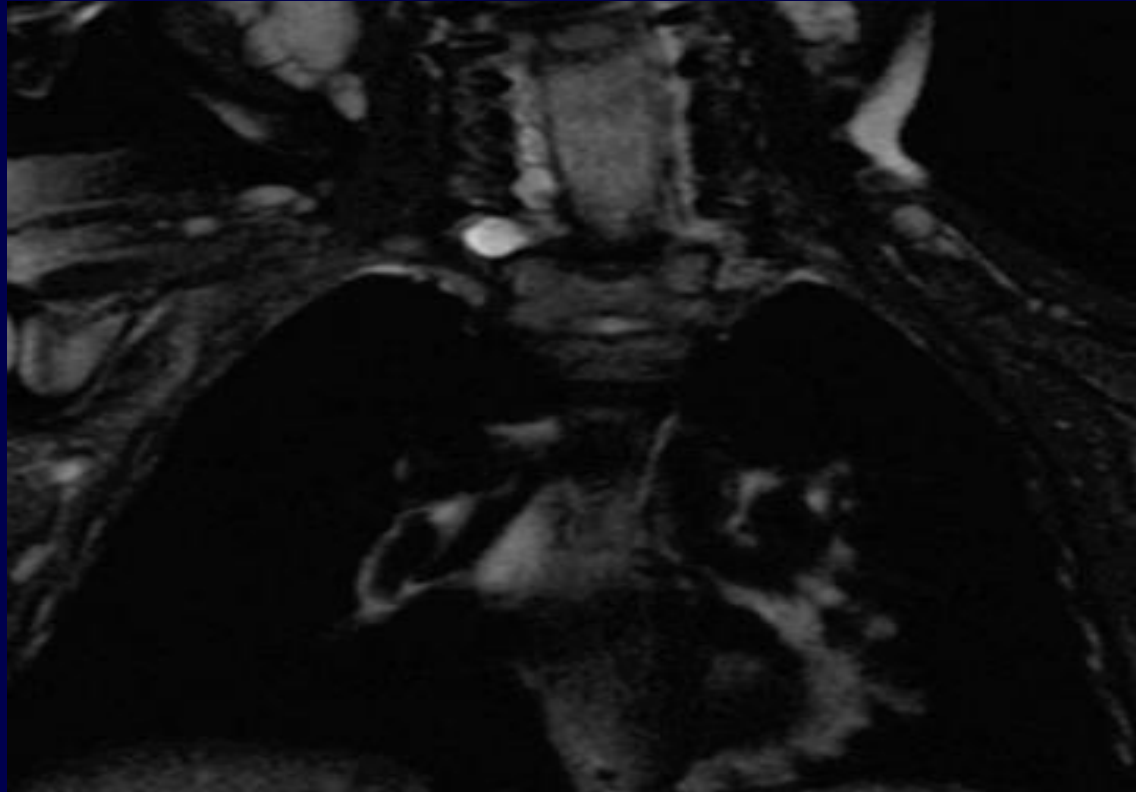
BP Injury



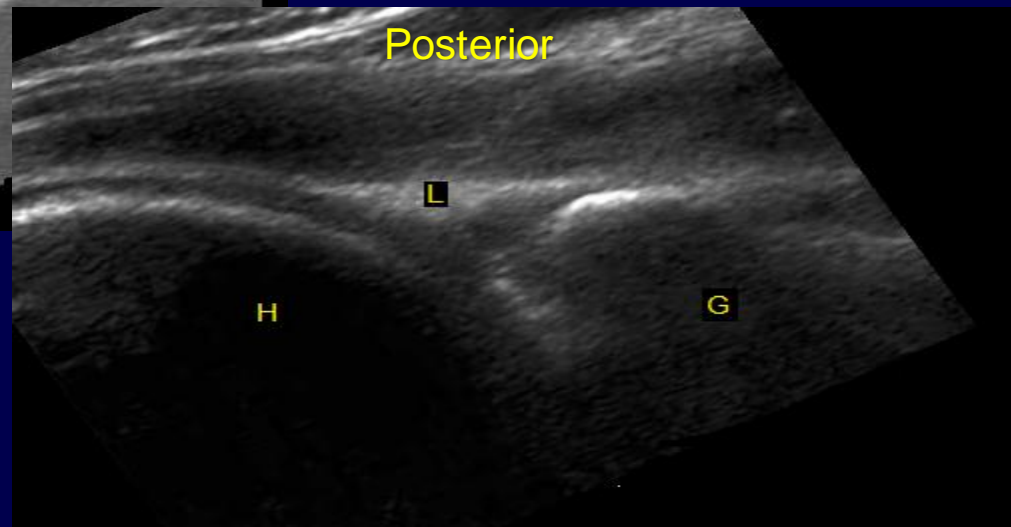
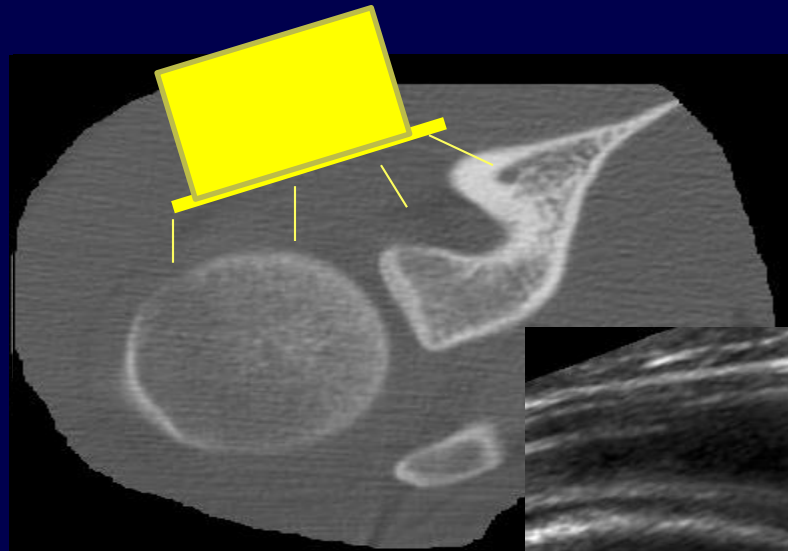
3D SPACE STIR MIP



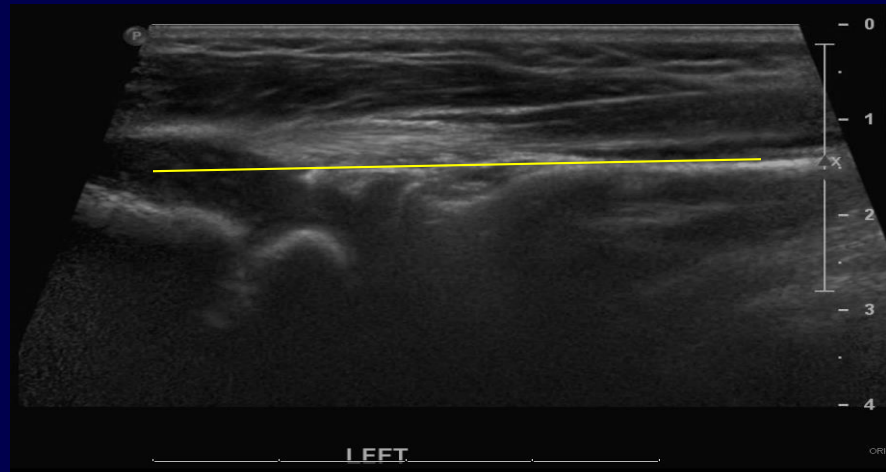
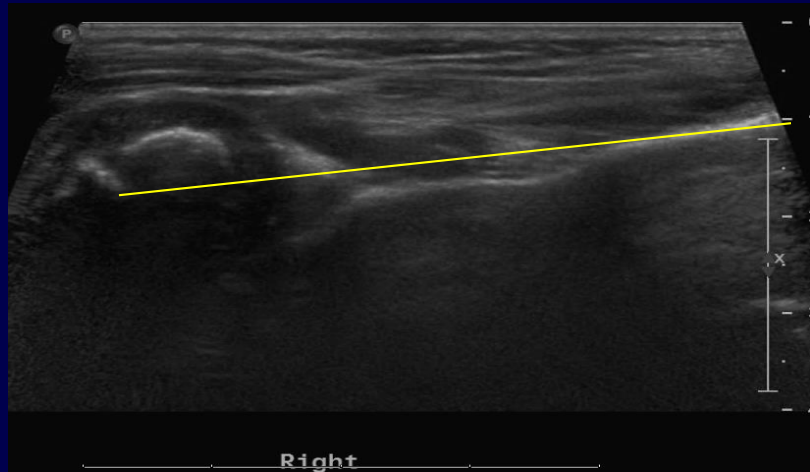
BP Injury



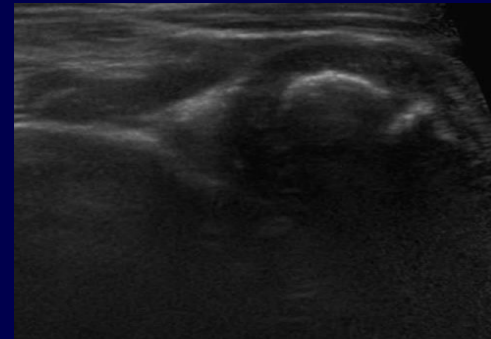
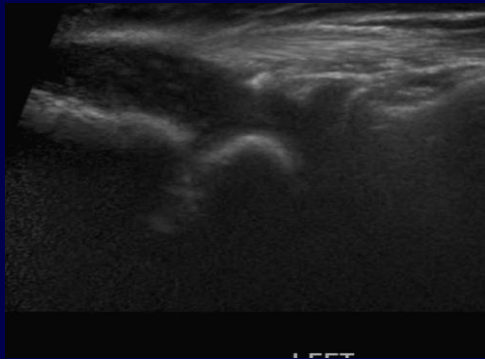
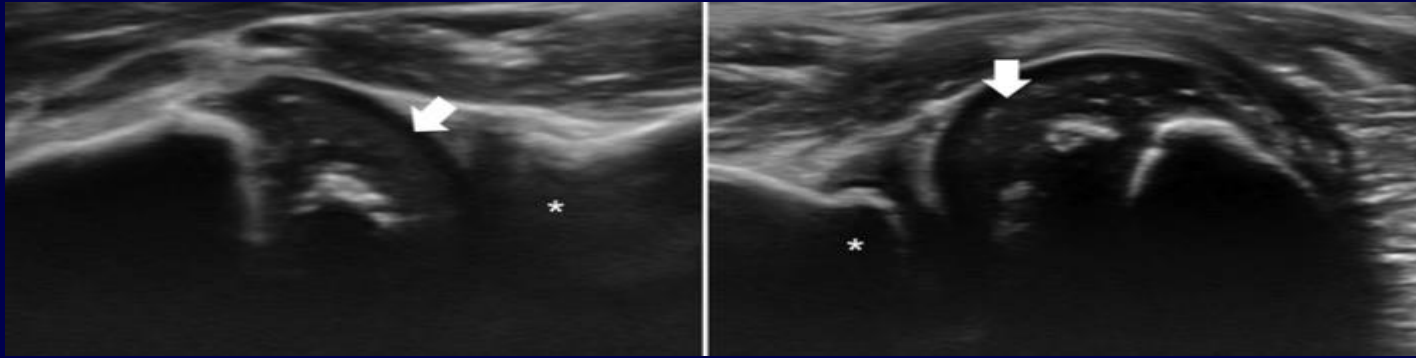
Imaging Plane



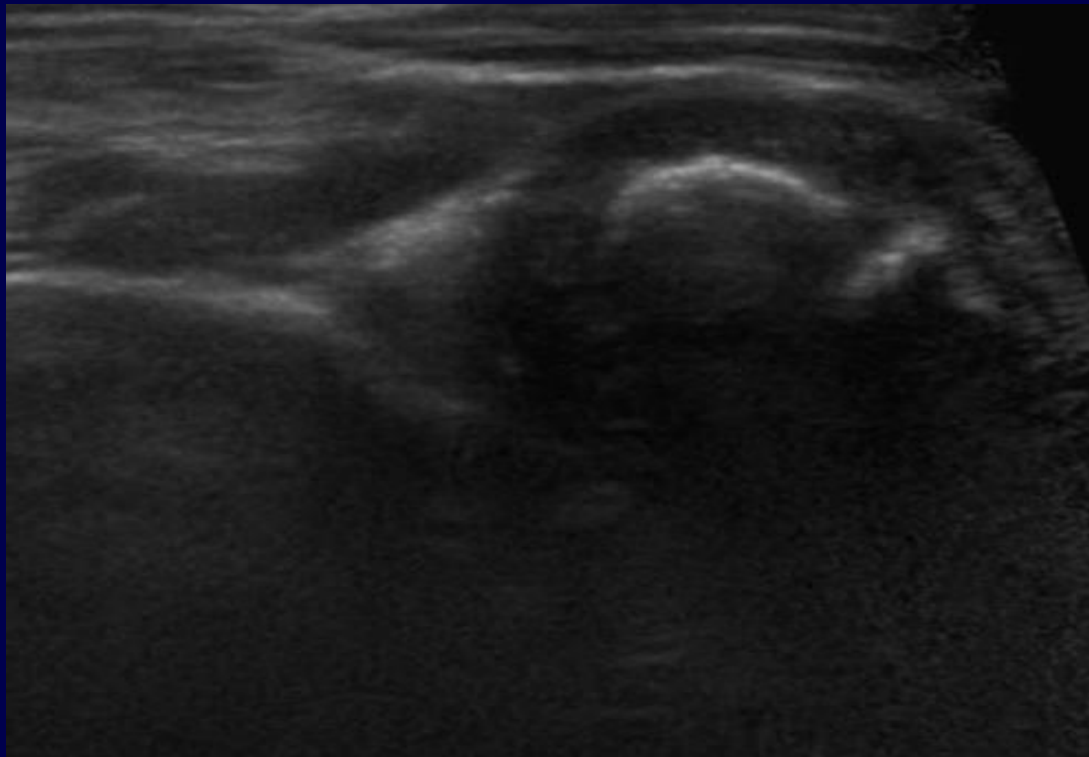
Glenoid Dysplasia



Glenoid Dysplasia



Dynamic Ultrasound Evaluation

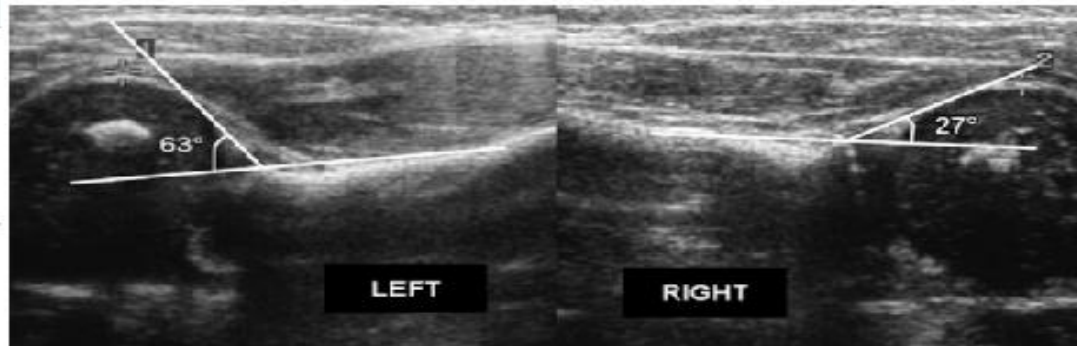


Glenoid Dysplasia

Brachial Plexus Birth Injury: US Screening for Glenohumeral Joint Instability¹

Tiina H. Pöyhkä, MD
Antti E. Lamminen, MD, PhD
Jari I. Peltonen, MD, PhD,
Mikko O. Kirjavainen, MD
Patrick J. Willamo, PT
Yrjänä Nietosvaara, MD, PhD

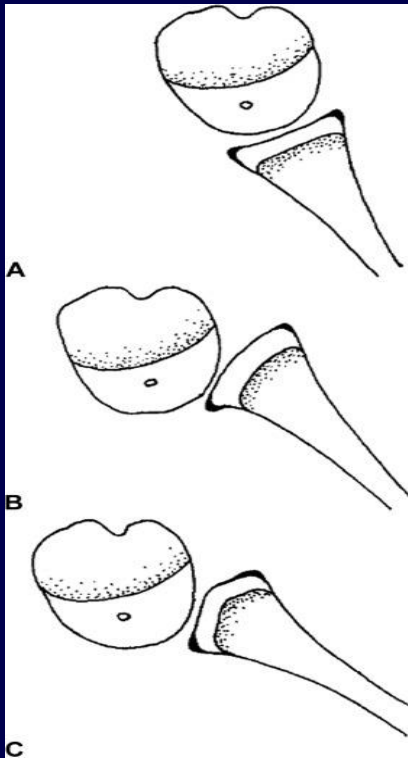
Radiology: Volume 254: Number 1—January 2010



- Normal alpha angle less than 30°



Glenoid Dysplasia

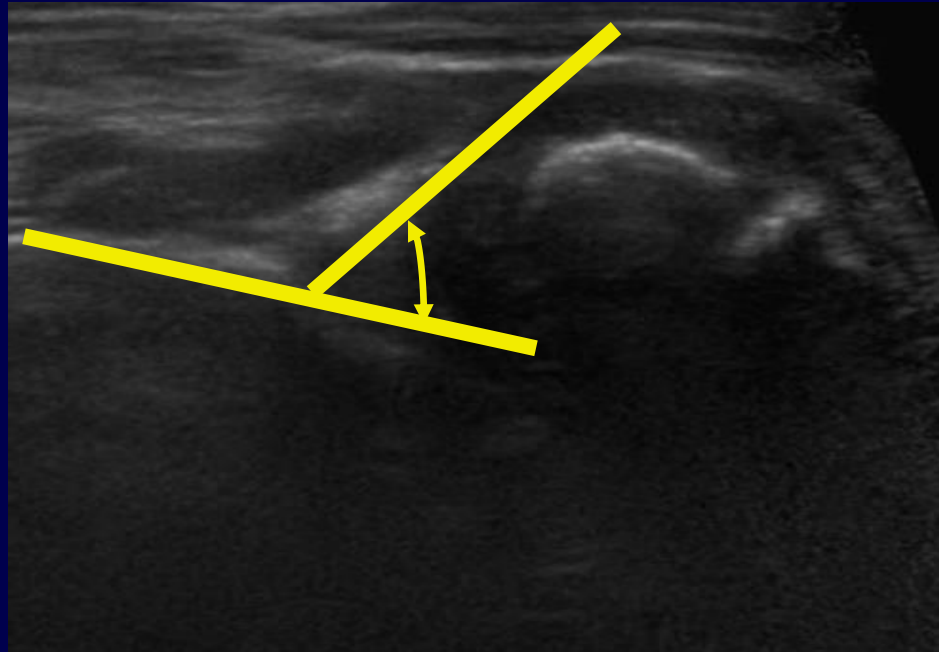


Grade - Waters Classification: GHD Based on Severity of Deformity and Subluxation

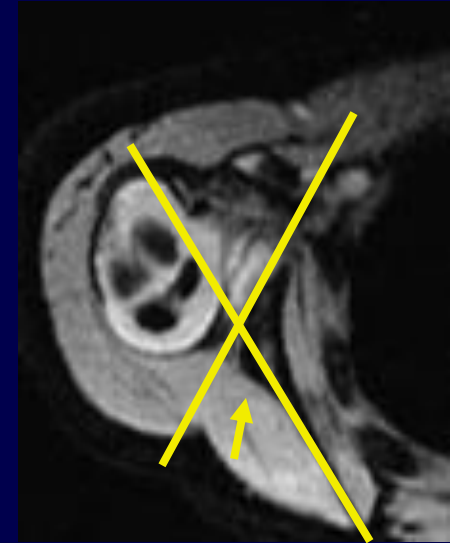
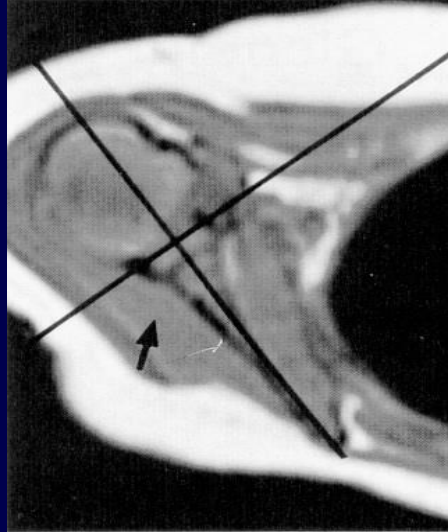
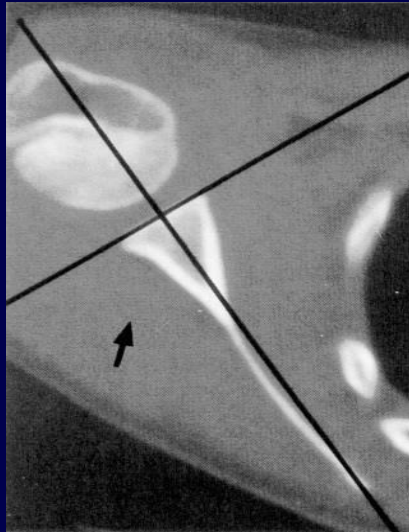
I	Normal glenoid (< 5° difference in retroversion compared with normal contralateral side)
II	Minimum deformity (> 5°, no posterior subluxation of humeral head)
III	Moderate (posterior subluxation < 35%)
IV	Severe (existence of pseudoglenoid)
V	Severe flattening of humeral head and glenoid, progressive or complete posterior dislocation of humeral head
VI	Joint dislocation
VII	Growth arrest of proximal humerus



Glenoid Dysplasia



Glenoid Dysplasia



- Angle = PM Quad angle – 90

Normal Values

- < 2 years = $-6.3 \pm 6.5^\circ$ (range, -23 to 8°)
- > 2 years = $-2.1 \pm 5.9^\circ$ (range, -16 to 12°)



BP Injury

- US: 3-6 months old
- CT
- MRI
- XR



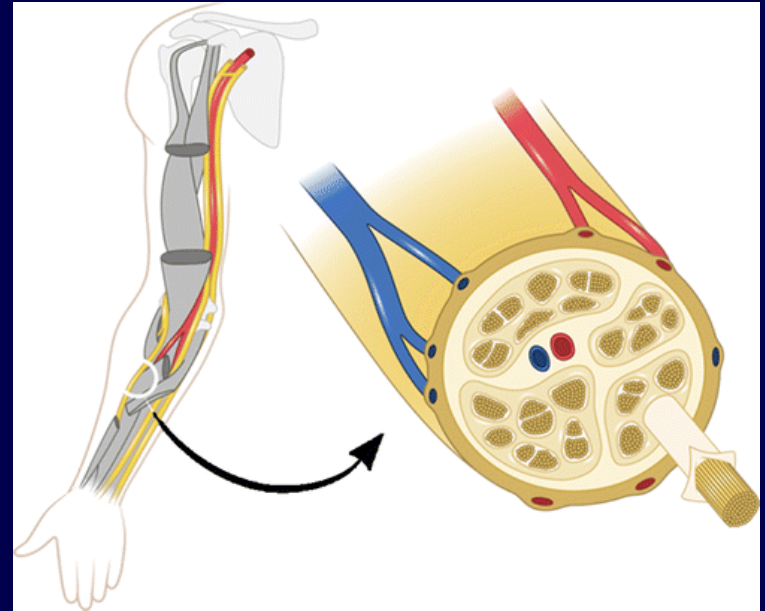
Management of BP Injury

- Primary nerve reconstruction
 - Best before 3 months
 - As late as 2 years
- Shoulder reduction
 - Tendon and ligament release
 - Tendon transfer
- Bone reconstruction



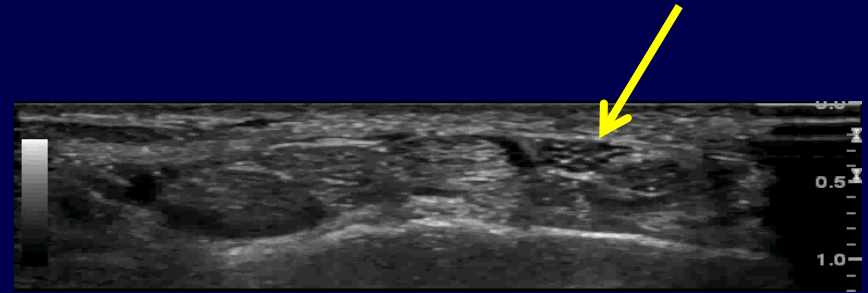
Sonography of Nerves

- Superior resolution than MRI
- More efficient
- Comparison to contralateral side
- Direct correlation with symptoms
- Dynamic imaging
- Must identify landmarks

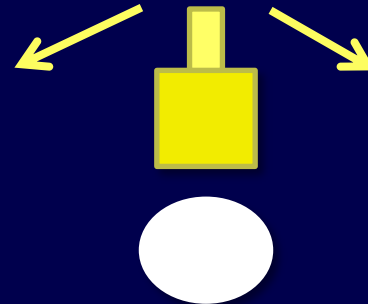


Sonography of Nerves

- **Ultrasound appearance:**
 - Hypoechoic nerve fascicles
 - Hyperechoic connective tissue
- **Short axis:**
 - Honeycomb, speckled appearance
 - Toggle transducer → use anisotropy to differentiate between tendon and nerve
- **Long axis:**
 - Linearly oriented nerve fascicles; more coarse than tendons



Median Nerve Example

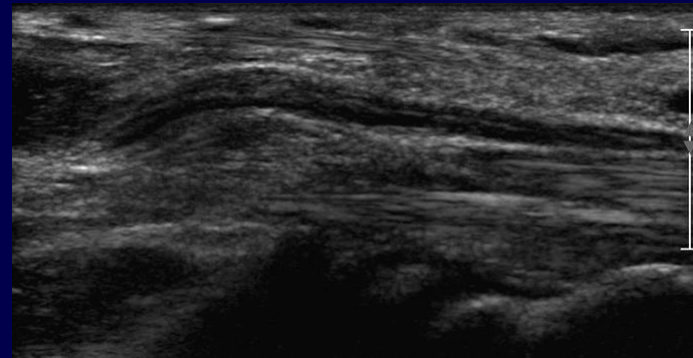


Ultrasound Landmarks

- Find a nerve ANYWHERE and follow it
- Compare to contralateral side

US of the Peripheral Nerves of the Upper Extremity: A Landmark Approach¹ RadioGraphics 2016; 36:452-463

US of the Peripheral Nerves of the Lower Extremity: A Landmark Approach¹ RadioGraphics 2016; 36:464-478

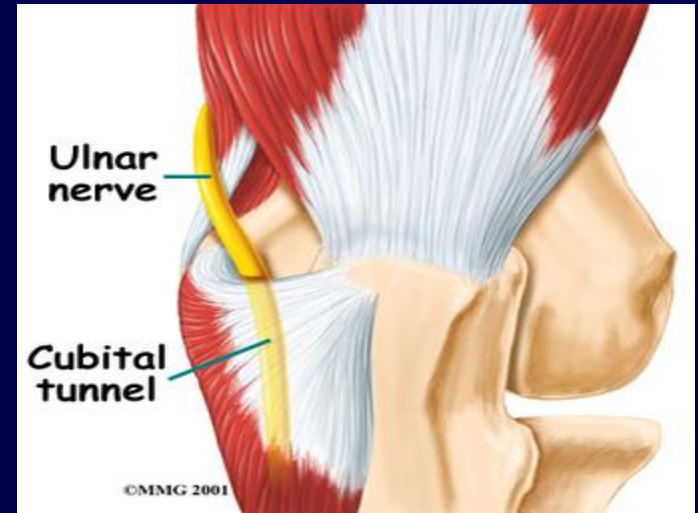
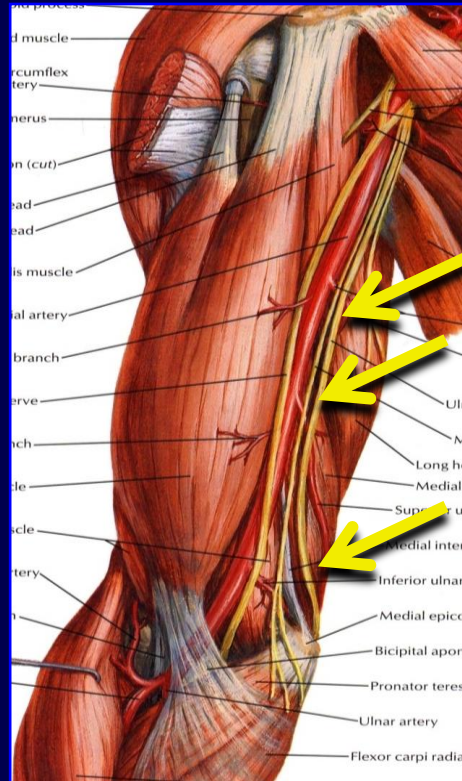


Ulnar Nerve – Upper Arm

From medial cord of brachial plexus

C8-T1 nerve roots

Runs from anterior to posterior compartments, under arcade of Struthers, then posterior to medial epicondyle into cubital tunnel



Posterior View of Elbow



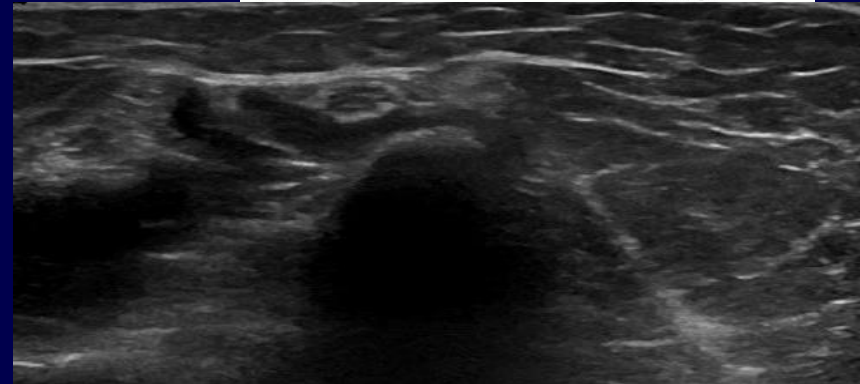
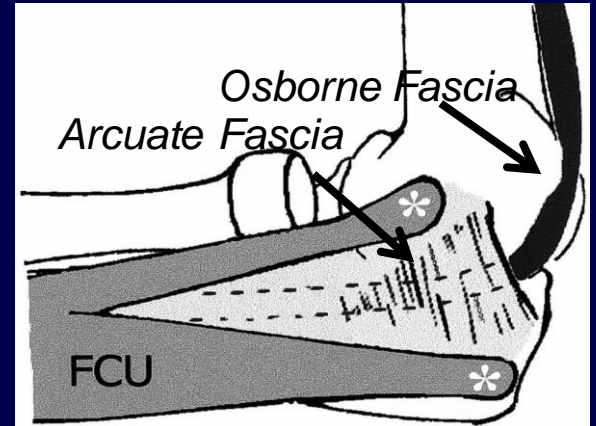
Ulnar Nerve – Upper Arm

- Largest unprotected nerve in the body
- Injury most frequent at medial epicondyle
- Sites of entrapment:
 - Medial epicondyle
 - Guyon's canal



Ulnar Nerve: Cubital Tunnel

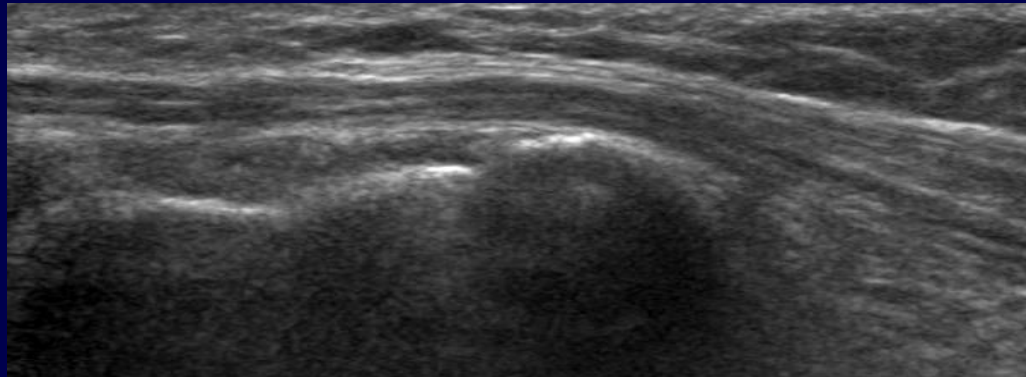
- Osborne Fascia
 - Cubital tunnel fascia
 - Between medial epicondyle, olecranon
- Cubital Tunnel
 - Distal to medial epicondyle
 - Between humeral and ulnar heads of flexor carpi ulnaris
 - Beneath arcuate ligament – distal expansion of cubital tunnel retinaculum



Ulnar Nerve: Cubital Tunnel



Ulnar Nerve: Cubital Tunnel



Long Axis

Courtesy of Jon Jacobson and Corrie Yablon



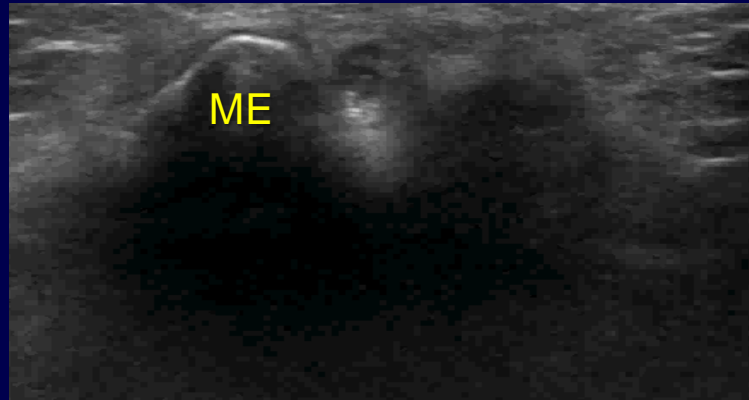
Ulnar Nerve Dislocation

- Occurs in elbow flexion
- Reduces in extension
- Nerve irritation, predisposes to injury
- 20% in asymptomatic volunteers
- Dynamic imaging
- Rule out anconeus epitrochlearis



Ulnar Nerve Dislocation

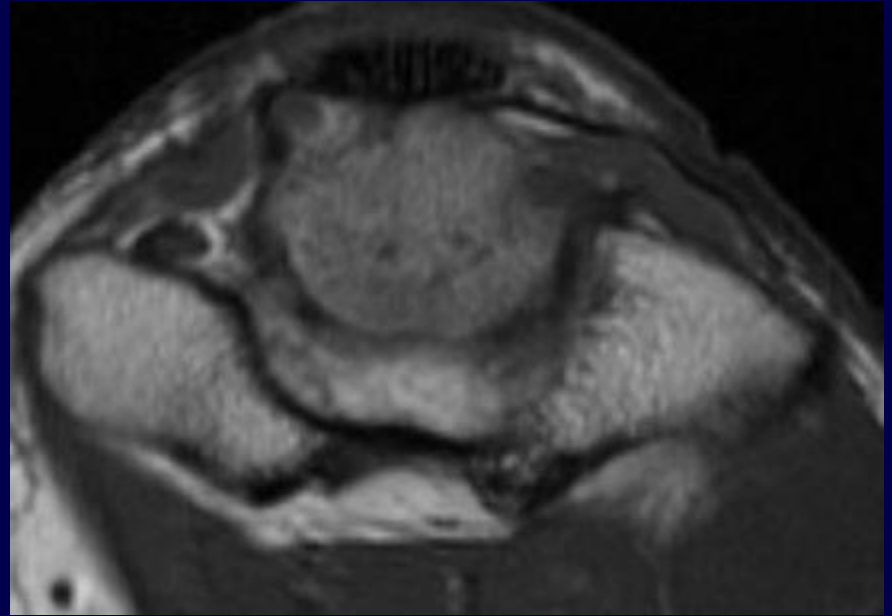
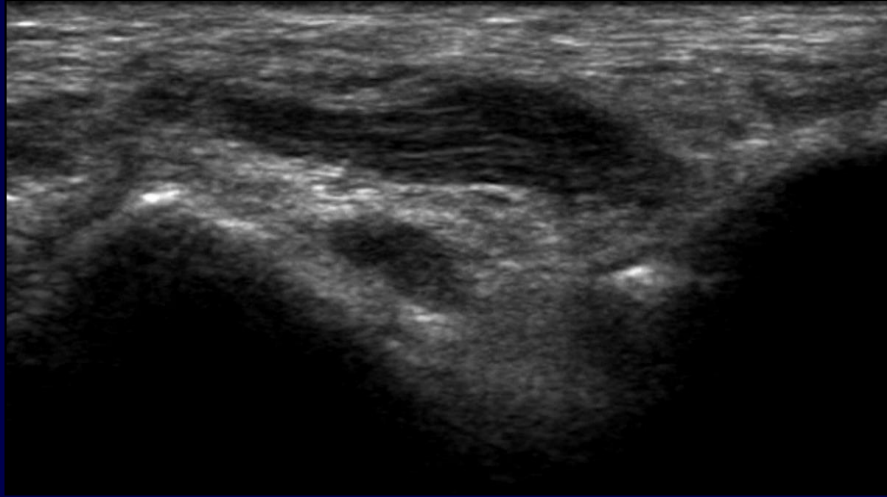
Subluxation



Dislocation

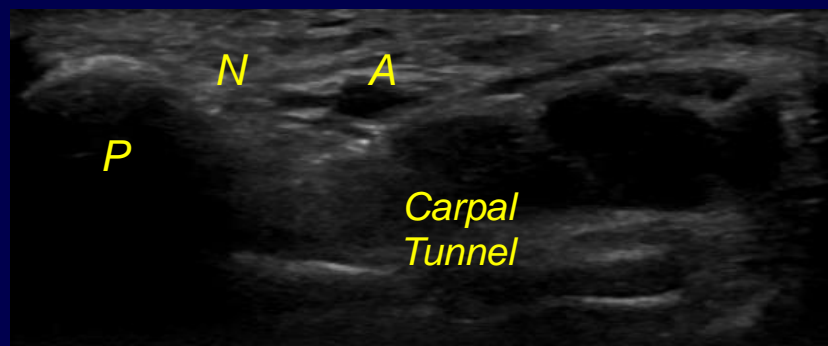
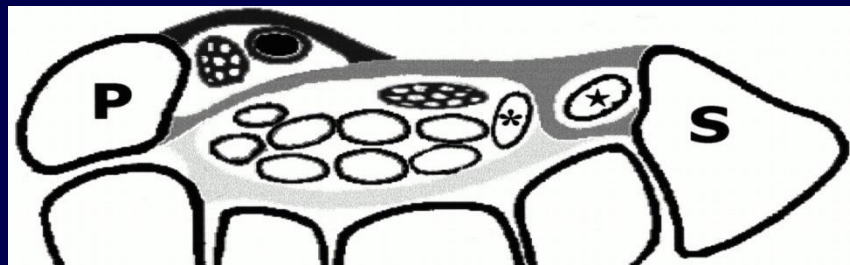


Anconeus Epitrochlearis

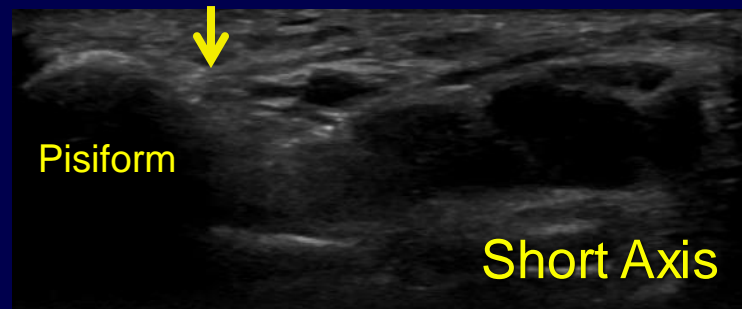


Wrist: Guyon's Canal

- Ulnar nerve enters wrist through Guyon's canal
- Boundaries:
 - Pisiform medially
 - Hook of hamate laterally
 - Flexor retinaculum forms floor of tunnel
- Contents:
 - Ulnar n, a, v
- Ulnar n. bifurcates distally



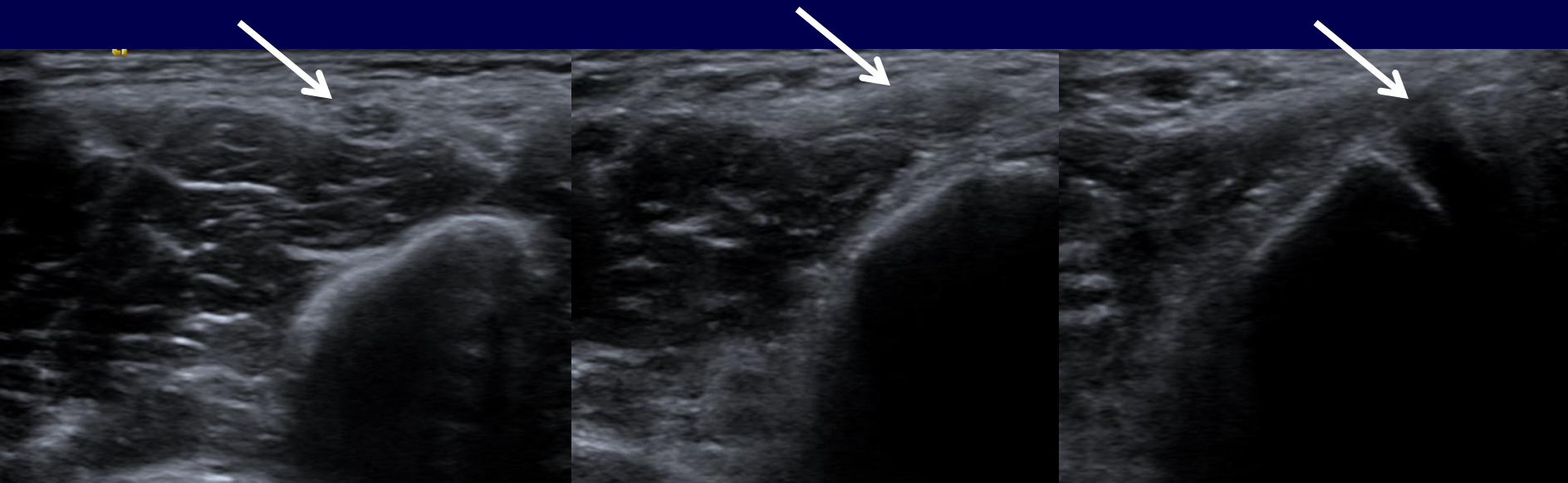
Wrist: Guyon's Canal



Case



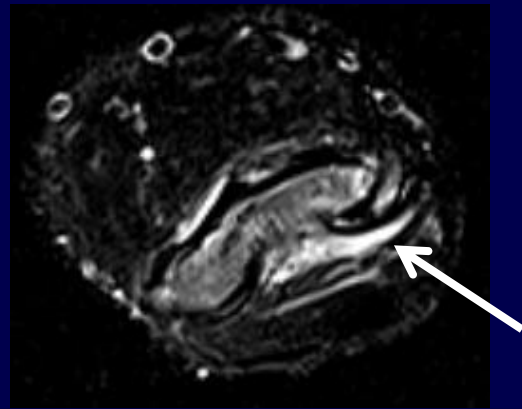
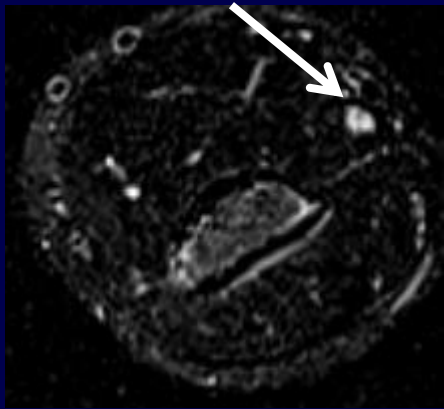
Case – could not flex fingers



Median Nerve



Median Nerve Entrapment



Summary

- Review sonography of fingers
- Posterior approach to evaluate glenoid and alignment
- Sonographic appearance of nerves



Thank you!

